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ABSTRACT

The six lessons contained in this guide provide students with a basic understanding of the scientific and environmental principles that govern modern package design and development. By completing the activities that accompany each of the lesson plans, students will be able to: (1) define a package and describe its functions; (2) differentiate between types of packages, including nature's packages; (3) describe how modern packaging evolved and why it is necessary; (4) understand the scientific, social, and environmental considerations that affect the design of a package; (5) discuss how packaging helps consumers reduce the amount of garbage they throw away; (6) define and identify different types of barriers; (7) define source reduction; and (8) create their own flexible package for a product. The lessons are not intended to stand alone and should be used to supplement existing curricula and classroom experiences in science, ecology, and home economics. A brief true-false pretest measuring knowledge of garbage and packaging begins the lessons. The correct pretest answers are explained in detail and address environmental facts and myths. The lesson plans contain objectives, background information, classroom activities, discussion questions, and extensions. Contains 10 references, a list of 20 periodicals, and 20 sources of additional information. A glossary of terms is included. (LZ)

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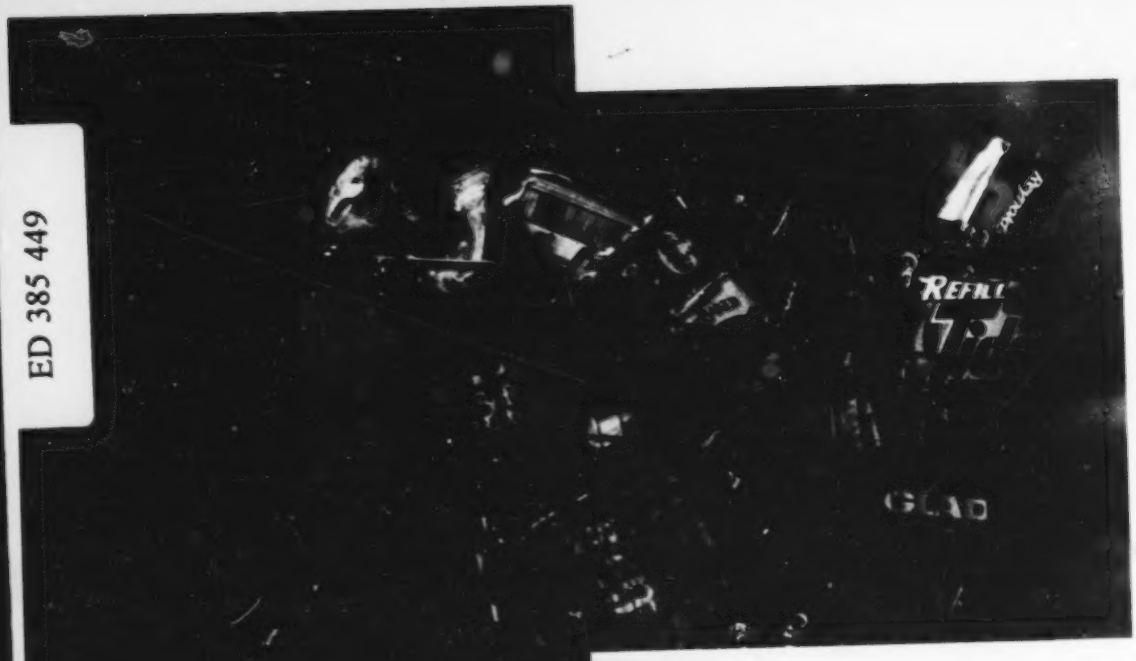

less waste in the *first* place.

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6 lessons on packaging & source reduction.

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Flexible Packaging Educational Foundation.

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Dear Educator:

The lessons contained in this guide provide students with a basic understanding of the scientific and environmental principles that govern modern package design and development. By completing the activities that accompany each of the enclosed lesson plans, students will be able to:

- *Define a package and describe its functions.*
- *Differentiate between types of packages, including nature's packages, flexible, rigid and semi-rigid packages and understand their importance.*
- *Describe how modern packaging evolved and why it is necessary.*
- *Understand the scientific, social and environmental considerations that affect the design of a package.*
- *Discuss how packaging helps consumers reduce the amount of garbage they throw away.*
- *Define and identify different types of barriers.*
- *Define source reduction.*
- *Create their own flexible package for a product.*

The lessons in this guide are not intended to stand alone, but rather should be used to supplement existing curricula and classroom experiences in science, ecology, and home economics.

The Flexible Packaging Educational Foundation (FPEF) is pleased to provide you with this educational resource. We believe it will help you and your students to better understand the role, functions and environmental considerations of packaging in our society.

Flexible Packaging Educational Foundation

Less Waste in the First Place™

Six Lessons on Packaging & Source Reduction

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Dear Educator:

We'd like to know what you think of this curriculum guide. Please take a moment to provide us with your ideas and suggestions by completing this evaluation form. Once you're done, please mail or fax the form to us at:

Flexible Packaging Educational Foundation
1090 Vermont Avenue, NW • Suite 500
Washington, D.C. 20005-4960
Attention: Director of Education
FAX: (202) 842-3841

Thank you! We rely on your expertise and look forward to your comments.

Feedback Form

Name _____ School Name _____

School Address _____

Subjects and Grades You Teach _____

Student Clubs/Groups You Sponsor _____

Please identify the lessons you taught from the *LESS WASTE IN THE FIRST PLACE*™ Lesson Guide.

- ❑ *The Package and Its Functions*
- ❑ *The Evolution of Modern Packaging and Distribution Systems*
- ❑ *Packaging and Source Reduction*
- ❑ *Types of Packages*
- ❑ *Barrier Properties*
- ❑ *Package Design: Creating a Flexible Package and Flexible Packaging Awards Competition*

Why did you choose these lessons? _____

What information or lesson was most useful? least useful? _____

Were the lessons applicable to your students' ability? _____

Why or why not? _____

What would you change to improve the lesson plans? _____

Flexible Packaging Educational Foundation
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Washington, D.C. 20005-4960

Attn: *Director of Education*

Many Americans have developed misperceptions about packaging materials and the volume of packaging produced and thrown away.

As an educator, you will most likely encounter one or more of these misperceptions from your students.

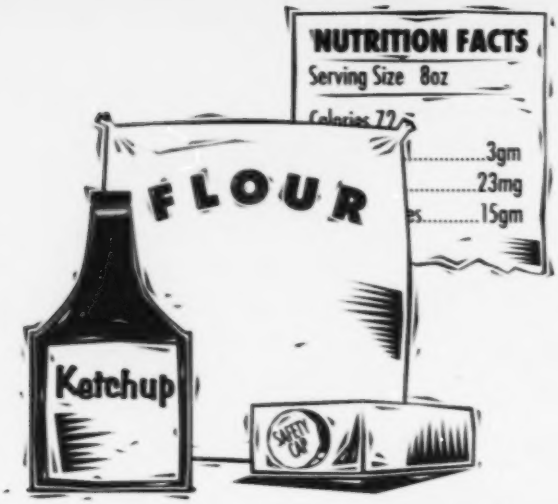
To help you address their questions, we have addressed several of the most widely believed waste management and packaging myths in the following text. We think you will find this information helpful in responding accurately to students' questions and comments. We encourage you to refer to this information frequently as you use this lesson plan guide.

Here's a short test you may give your students before using this guide:

Pre-test

1) Most products are "overpackaged."	True	False
2) Packaging is unnecessary.	True	False
3) Recycling is the single best way to solve our waste management problems.	True	False
4) Plastic is the biggest contributor to America's landfills.	True	False
5) A lot of biodegradation occurs in landfills.	True	False
6) Fast-food packaging, polystyrene foam and disposable diapers are major constituents of American garbage.	True	False

(see page 41 for the answers)



the package and its functions.

lesson 1

Objectives

After completing this lesson, students will be able to:

- *Define a package.*
- *Describe the four primary functions of a package.*
- *Discuss why packages that are constructed of different materials perform certain functions.*

Materials Needed

Packages for orange juice made from different materials. (The lesson will work best if you select a product, such as orange juice or coffee, that can be purchased in a number of different packages.)

Using the orange juice/drink example, the packaging display will include the following types of packages: single-serving steel can, 12 oz. aluminum can, single-serving or larger glass bottle, paperboard carton, drink box, paperboard tube w/ metal ends (for frozen concentrate), plastic jug (orange drink), and plastic 2-liter bottle (orange soft drink).

Using the coffee example, the packaging display will include the following types of packages: steel can, vacuum brick pack, paperboard canister with filter packs inside, glass jar, plastic jar or, if freshly ground in the store, a small paper bag.

Background Information

What is a package?

A package is the container that encloses products, items or other packages. Packages come in many forms including wraps, pouches, bags, boxes, cups, trays, cans, tubes, bottles and jars. Packages are designed not only to contain a given product, but also to protect and preserve the product; provide information about the product to the consumer; and make the product easier or more convenient to use.

What are the major functions of a package?

By definition, a package must perform one or more of the following essential functions:

Containment means that the package provides a way of holding or carrying a product. Just think, peanut butter without a jar would be quite a mess! Packages make it possible for manufacturers to ship products to stores and for grocers to stock and display different products in their supermarkets. Packages also make it possible for consumers to carry products home and store them in the pantry or refrigerator.

Protection and preservation are the next packaging functions. They ensure that the product the consumer receives is usable and has not been broken, damaged, contaminated or spoiled along the way. For example, specially designed cartons protect eggs from breaking, and paperboard boxes protect cereal from becoming just a bunch of crumbs. Also, canning and frozen food processes allow consumers to purchase high-quality, uncontaminated foods any time of the year, regardless of what is in season. Similarly, tamper-resistant and tamper-evident packages found on many medicine bottles and some food containers assure consumers that the products they purchase have not been altered in any way.

Information tells the consumer what is in the package. Packages (or package labels) typically provide the following types of information: the quantity of the product in the package; instructions or precautions for storing and using the product; nutritional, dietary and ingredient data; and information about the product's manufacturer. Package information helps the consumer make informed choices about products. It can also help sell the product by providing information about the brand and quality of the product; special features of the product or its package; rebate and coupon offers; or even recipe and serving suggestions.

Utility-of-use (convenience) is the fourth packaging function. Packages make it easy for consumers to handle, dispense and use the products they contain. For example, plastic "squeezable" bottles allow consumers to easily dispense the desired amount of various products, from hand lotion and shampoo to mustard and ketchup. The plastic squeeze bottle is convenient in other ways, notably that it is resistant to breakage and is lighter and easier to carry. The choice of package sizes, ranging from individual portions to large economy sizes, is an example of utility-of-use to satisfy particular needs, including those of an individual versus a large family versus an institutional customer like the food purchasing director for an entire school district. Aerosol dispensers, microwave packaging and cook-in eat-in packages are other examples of how packaging makes products easier to use.

Encourage students to think of other packages that make the product they contain easier to use. Some of their examples might include:

Expandable bags make it easy to quickly prepare microwave popcorn.
Facial tissues come in a box designed to dispense just one tissue at a time.
Drink boxes are compact and fit easily in a lunch box. They also come with a straw to sip the beverage.
Spray triggers and unbreakable plastic bottles make many household products, such as window and carpet cleaner, easy and safe to use.
Cereal boxes have reclosable tops that keep contents fresh.

Product–to–package compatibility

In addition to performing the essential functions described above, the best package for any given product will be the package that is most compatible with the product it contains. Modern packaging scientists must consider many different factors in determining whether packages and the products they contain are compatible, and more importantly, whether they will remain compatible as the product is transported, stored and distributed to the final consumer.

Three factors cannot be overlooked in determining product–to–package compatibility:

Chemical compatibility—Packaging scientists must make sure that the physical and chemical properties of the product are compatible with the package and vice versa. For example, some food products, such as tomato paste and orange juice, are naturally very acidic. The acidity of these foods can deteriorate certain packaging materials, including some plastics and laminates. Also, solvents such as alcohols, ketones or hydrocarbons can destroy the package containing them. Yet alcohols are common ingredients of moist towelettes, scented toiletries, and of course alcoholic beverages. From another perspective, some products may be adversely affected by exposure to oxygen, light and moisture. Consequently, packages for these types of products must feature a barrier to reduce the impact of these environmental elements (see Lesson 4). To ensure that the integrity of both the product and package is maintained throughout a product's shelf-life, properties such as these must be carefully considered in evaluating chemical compatibility.

Physical endurance—The selection of a packaging material must also take into consideration the physical stress exerted on the package by the product. Ground coffee, for example, is highly abrasive. Placing ground coffee into a plastic pouch creates unusually tough demands on the endurance of the package. Other food products such as corn chips, frozen vegetables and noodles can also cut, tear and severely abrade packaging materials. Another example: In order to prevent puncturing of packaging material, meat packers now use a bone guard (a wax-impregnated cloth) to cover sharp bone edges. In addition, the materials used for many pouches must be tough enough to hang on display pegs without ripping.

Product appearance—The package selected for a given product must be able to preserve and display the product effectively. For instance, what happens when you put a wet or greasy product in a plain paper bag? Not sure, try it out! The excess moisture or oil will eventually saturate the bag, creating unsightly stains and compromising the strength of the package. Some products, such as fresh meats, fruits and vegetables, cheeses and cakes, depend upon transparent packaging to enable the consumer to check the product for freshness and quality. Finally, packaging is designed to illustrate how the product is used and to assist the consumer with preparation. For example, products that must be shielded from the harmful effects of light are protected by an opaque wrapper or container. For instance, low-fat baked goods, like Nabisco's new Snackwell's cookies and crackers require special protection since they do not contain fat, a substance needed to keep the product moist. Therefore, they are enclosed in both an opaque bag and a box. This added protection helps to keep the product fresh. To help consumers in their shopping decisions, packaging makes use of graphics to inform, instruct, and market.

Clearly, packaging scientists must consider these and many other factors in evaluating the long-term compatibility of a product and its package.

Lesson One
Implementation

Classroom Demonstration

Direct students (individually or in groups) to bring in several examples of packages for the product you have identified (e.g. coffee or orange juice). Assemble a display of the different packages at the front of the classroom. Before using the discussion questions below, have students critically analyze each package. Students can perform this task by describing the package. It is important to remind the students that they should only describe the package and not make any judgments about it. (e.g., The package is blue, labeled as microwavable, contains 10g. fat, etc.) Using the observations and questions below, lead the class through a discussion of the packaging examples you have assembled.

Discussion Questions

The following questions should be applied to each packaging example. The answers provided below are suggested responses to a discussion of the brick pack package for coffee.

1. Does this product need a package? Why or why not?

Yes, this product needs a package in order to conveniently and safely contain the ground coffee for consumer use. If the package were not present, the consumer might need to purchase ground coffee from a large bin, scoop it out, and carry it home in a paper or plastic bag (or other package) brought from home. The large bin of ground coffee would not stay as fresh as the packaged coffee and would also risk contamination by other consumers or perhaps insects.

2. Is this package a better container than any of the other packages represented? Why or why not?

The brick pack package is very compact and uses very little packaging material, but it holds a lot of product. This means that less energy and fewer resources (e.g. aluminum foil, paper and plastic) are used to make the package. The package is also very lightweight and requires less fuel (e.g. gasoline) and fewer trucks to transport it from the coffee manufacturer to the grocery store. Also, a square package is more efficient to store and transport than a can or round package. Other coffee packages, such as metal (steel) cans or glass jars, may be easy to recycle but are also heavier, take up more space in a truck, and consequently cost more to transport. Compared to other coffee packages, the brick pack creates much less waste to discard while holding the same amount as a steel can, even when recycling is factored in, and especially where recycling systems do not exist.

3. How does this package protect or preserve the product?

The brick pack is vacuum sealed to lock out moisture and oxygen so that the coffee stays very fresh until the package is opened by the consumer. Vacuum sealing removes substantially all air from the container, immobilizes the contents and diminishes the volume of the package. The brick pack is also very durable. Due to its multi-layer structure, it will not easily break or split open.

4. What information does the package provide to the consumer? Why is this important?

Among other information, the package tells the consumer how much coffee is in the container, who manufactured the coffee, how the coffee should be stored, and how the coffee should be prepared. This information is important because it helps the consumer determine how much coffee to purchase as well as how to use and prepare the coffee. The package may also help to sell the product by providing the consumer with information about the brand name of the product, coupon or rebate offers, or other special information.

5. Does this package make the product easier for the consumer to use? If yes, how?

The brick pack package is easy to store at home without taking up a lot of space in the refrigerator or cupboard. Also, the package keeps the product fresh until the consumer is ready to use it. Once the package is opened, it can be resealed to preserve freshness.

Homework Assignment

Ask students to select a package and product of their choice and describe in one or two written paragraphs how the package they have selected performs the four major packaging functions. Ask students to bring their package and product to class to share their analysis with the rest of the class.

Extension

For older or advanced students. Assign students (individually or in groups) to select a packaged product of their choice. Next, supervise students as they conduct their own research to examine the compatibility of the product and package they have selected, using the three factors described earlier.

For example, students may choose to examine how fresh beef is packaged and why this package is compatible with the product. How might the packaging for fresh beef be improved? What are some of the problems associated with meat packaging? Is fresh meat vulnerable when exposed to certain environmental elements? How can these environmental elements (e.g. oxygen, light, etc.) affect the quality of the product? (See Case Study below as an example for this assignment.)

Or, students may wish to examine how the package for microwave popcorn or a microwave dinner works. Why are the packaging materials appropriate for use in a microwave oven? For use in a traditional oven? How do certain microwave packages promote browning of the food product? How does the package for microwave brownies work? What factors had to be considered in selecting the packaging materials?

Students may present their findings in an oral presentation or written document. Research can be conducted using library resources and packaging periodicals or by calling the product manufacturer. Often they list a toll free number on their packaging. In addition, several appropriate resources are provided at the back of this lesson guide.

Case Study

In recent years, the consumption of red meat has declined in the United States. As consumers bought less meat, more meat began to spoil. This forced the meat packaging industry to look at how it could preserve the meat longer. Traditional shelf life for meat had been two to three days. The development of new technology has advanced the shelf life to 28 days.

It's called CAP (controlled atmosphere package). CAP seals the meat in a hermetically-sealed (airtight) package and then flushes the meat with a mixture of nitrogen and carbon dioxide. This procedure eliminates most oxygen and provides an airtight seal around the meat to protect it from spoilage without additives or freezing.

Not only does this process extend the shelf life for red meat, it extends the distribution area for the product and saves the grocery store money. Often, supermarkets can not afford to employ a full-time butcher. The CAP meat permits the grocer to buy cuts of meat ready for sale to the consumer, eliminating the need for an in-house butcher. In addition to saving the grocer money and ultimately the consumer, the CAP process permits distribution of red meat to a larger geographic area and provides consumers with an extended variety of selections.

types of packages.

lesson 2

Objectives

After completing this lesson, students will be able to:

- *List examples of natural packages.*
- *Identify modern manufactured packages.*
- *Define a rigid package.*
- *Define a flexible package.*
- *Define a semi-rigid package.*
- *Compare and contrast rigid and flexible packages.*

Background Information

Nature's packages

Some of the most original packages ever created are found in the natural environment. Many of these packages perform functiohs similar to those of modern manufactured packages, yet they were made by Mother Nature, using organic materials. Identified by product and package, some examples include:

Product	Package	Product	Package
Banana	*Banana peel*	Peanut	*Peanut shell*
Coconut meat & milk	*Shell*	Peas	*Pea pod*
Coffee bean	*Shell*	Potato	*Potato skin*
Corn on the cob	*Husk*	Orange	*Orange peel*
Egg	*Egg shell*		

These are just a few examples. Encourage your students to think of others.

It is worthwhile to note that many of the products found in the produce section of the supermarket are minimally packaged or not packaged at all. Many fruits, vegetables and nuts are naturally contained in their own unique "packages." For the most part, these packages function very well to contain and protect the products they hold.

However, natural packages can have limitations when the functions of preservation, information and utility-of-use are examined. For instance, even with refrigeration, fresh produce has a limited storage life before it rots or spoils. It is useful to remember that before modern food processing and packaging methods became commonplace in the United States, consumers who wanted to eat summer-grown fruits and vegetables during the winter had to rely on products canned at home to stock their pantries. Salted, smoked and dried meats were also commonly eaten during the winter months.

Natural packages also do not provide the consumer with information about, for instance, the nutritional or caloric value of the products they contain. Preparation instructions and serving suggestions also do not exist. For example, the natural package or skin of an eggplant or avocado tells the consumer nothing about how to prepare or serve these vegetables.

Some natural packages can also be inconvenient for the consumer to handle or use. For example, pineapples are very prickly to handle and other produce items, like apples and oranges, tend to bruise easily.

Modern manufactured packages

Today, food and other consumer products—from household cleaning supplies to medicines to pet food—are distributed to supermarkets in a wide variety of packages to accommodate the different needs of buyers. Modern packages come in many shapes and sizes and are made from many different materials. They include paperboard boxes, canisters and tubes; plastic films, wraps, bottles and jars; paper bags and wraps; glass bottles and jars; steel cans and lids; and aluminum cans and foils. And, though packaging choices may already seem limitless, every year packaging engineers are discovering new ways to make better packages.

Modern packages can be grouped into three major types: rigid packages, flexible packages, and packages that combine both rigid and flexible materials. Each type of package provides unique characteristics which can improve the way a product is transported from the farm or manufacturing facility to the warehouse to the retailer and, finally, to the consumer. And, every package has a role in preserving the integrity of the product it holds.

Rigid Packages—Rigid packaging can be composed of paper, plastic, glass, steel or aluminum and is characterized by its stiff or unyielding construction. Examples of rigid packaging are cardboard and paperboard boxes; glass bottles and jars; plastic bottles, jars, caps and lids; and steel or aluminum cans.

Most rigid packages are very durable and offer excellent protection and preservation for certain types of products. Examples of products typically contained in rigid packages are vegetables and soups in steel cans; cereals and crackers in paperboard boxes; and soft drinks in glass or plastic bottles or aluminum cans.

However, those same protective qualities may also require the use of larger and heavier packaging to achieve the necessary degree of product preservation. One example is electronic equipment. In contrast, product manufacturers may avoid rigid packaging for bulky or heavier products to make it easier on consumers. For example, a 60-pound box of dog food or garden mulch would be heavy and cumbersome for the typical consumer to handle, transport, and store, and could mean more packaging to send to the landfill.

Flexible Packages—Flexible packaging is composed of plastic film, paper, aluminum foil, or any combination of these materials. It has no shape of its own, but conforms to the shape of the product it contains, compressing easily and requiring a minimal amount of material to manufacture. Generally, it takes the shape of bags, pouches, labels and wraps.

Examples of flexible packaging are the plastic wraps that protect meat and poultry; frozen food, snack food and microwave bags; bread wrappers and bags; sterile wrappers for medical supplies; labels for food and pharmaceutical products; dry cleaning and grocery bags; pet food and cat litter bags; and candy wrappers.

Flexible packaging materials are also used to create a barrier between the product and the environment. In food and pharmaceutical packaging, flexible materials are used to seal in freshness and lock out potentially damaging environmental elements, like excess moisture, light and oxygen, that could affect the quality, taste or effectiveness of the food or medication. Tamper-resistant and tamper-evident packages and seals often use flexible materials to protect the consumer from purchasing or using a contaminated product. Flexible packages also make otherwise bulky items easier for the consumer to handle. The dog food and garden mulch examples offered above illustrate this point. Flexible plastic, paper and foil bags allow retailers and consumers to easily handle, transport and store many different products, from frozen vegetables or french fries to a 20-pound bag of potatoes or cat litter.

Rigid and Flexible Packages

Some products found in today's supermarkets have packages that combine rigid and flexible materials. A good example of this type of package is the "bag-in-box" construction used for foods like cereal, crackers and cookies. The box is rigid while the enclosed bag is flexible. The durable yet lightweight box functions to protect the cereal from being crushed. The flexible plastic, foil or waxed paper bag functions to contain the cereal within the box and to preserve its freshness. Another example is the "shrink wrap" beverage pack for glass or aluminum beverage 6-packs. Flexible materials are also often used as a secondary package to further preserve the freshness or integrity of a product. One example is the foil liner used over the mouth of containers for peanut butter, ketchup, instant coffee and spices. Another example is the foil liner found on the back of blister packs for cold capsules and other medicines.

The list on the next page provides examples of several products which can be purchased in a rigid package, a flexible package or a package that combines rigid and flexible materials.

examples of flexible and rigid packaging

RIGID PACKAGE	FLEXIBLE PACKAGE	BOTH
Baby Wipes		
Plastic tub	Foil refill pack	
Gravy		
Glass jar Steel can	Foil & paper envelopes	
Peanuts		
Glass jar Paperboard canister w/ metal ends and plastic lid Aluminum can w/ plastic lid	Vacuum "brick" pack	
Peas		
Frozen in paperboard box Steel can	Frozen in plastic bag Dried in plastic bag Fresh peas from produce section	
Prunes		
Glass jar Paperboard box	Foil bag	
Salad Dressing		
Plastic bottle Glass bottle	Paper and foil envelope	Paperboard box w/ foil paper envelopes inside
Coffee		
Steel can	Vacuum "brick" pack	Paperboard canister w/ filter packs inside Glass jar w/ foil liner Plastic jar w/ foil liner
Dog Food		
Plastic jug Steel can	Paper bag	Plastic bags in paperboard box
Orange Juice or Soft Drink		
Small or large glass bottle Aluminum can Steel can Paperboard carton Plastic bottle or jug	Juice or drink box Powdered mix in paper or foil envelope (e.g. Kool-Aid™)	Paperboard tube for frozen concentrate w/metal ends and plastic peel-off seal
Popcorn		
Glass or plastic jar Jiffy Pop™ package	Plastic bag	Paperboard box w/ microwave bags inside
Potato Chips		
Paperboard canister w/ metal ends and plastic lid	Paper or foil bag	Paperboard box w/ plastic bag(s) inside

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Lesson Two
Implementation

Classroom Activity

Using clippings and illustrations from magazines, grocery coupon circulars, grocery store newspaper ads or other sources, ask students to create posters or flash cards illustrating natural, rigid and flexible packaging options for each of the following four products: coffee, corn, peanuts, and peas. Challenge students to think of other examples of products from various product categories that can be purchased in a flexible or rigid package. (Other product categories could include dairy products, baby care items, pet food, personal hygiene products, drink mixes, beverages, etc.)

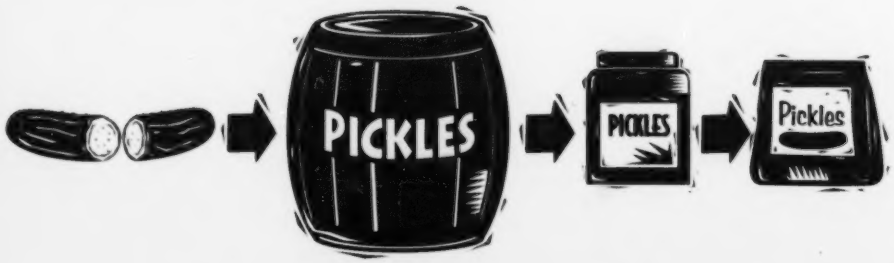
Using the students' posters or flash cards, lead a class discussion to explore how each of the packages illustrated—rigid and flexible—performs the packaging functions described in Lesson 1. The discussion of each package should focus on the types of questions listed below.

Discussion Questions

1. What materials are used to make this package?
2. Is this a rigid package, flexible package or a combination of both types? How can you tell?
3. What are the advantages and disadvantages of these types of packages?
4. How does the package protect the product from spoilage or other damage?
5. How is the product displayed in the store? Does the package make it easier to display?
6. How does the consumer store it at home?
7. Does the package make the product easier to store at home?
   If there was no package, how might the consumer store the product at home?

Extension

Depending upon the students' ages and abilities, this activity can be expanded to require students to write a short analysis (one paragraph) describing what they think are the advantages and disadvantages of the different packaging options for one of the given products. For example, if coffee is the selected product, the student will write a paragraph describing the advantages and disadvantages of each package option for coffee, keeping in mind how each package performs the four primary packaging functions.



the evolution of modern packaging and distribution systems.

lesson 3

Objectives

After completing this lesson, students will be able to:

- *List examples of early forms of packaging.*
- *List examples of early manufactured packaging.*
- *Identify how the Industrial Revolution changed the way food products were packaged and distributed.*
- *Explain why the creation of the supermarket required new changes in packaging.*
- *Explain why packaging is important to modern distribution systems.*
- *Explain how packaging has helped improve the quality of life.*

Background Information

Early forms of packaging

The earliest packages were created more than 10,000 years ago using materials that were readily available in the natural environment. These packages often served as containers for items necessary to survival, such as food and water. Coconut and sea shells became drinking and storage vessels. Baskets woven from plant fibers and water or wine pouches made from animal skins are other examples of early packages.

Early manufactured packaging

As early as 6000 B.C., clay pots, bowls, vases and other clay containers were used as forms of packaging by ancient societies. By 2500 B.C., glass was first used in Egypt and Babylon to fashion jewelry and small containers. A major development in the manufacture of glass containers occurred around the first century A.D., when Syrian artisans found that molten glass could be blown into different shapes, sizes and thicknesses. This discovery eventually led to the mass production and wide availability of all types of glass containers. In the early 1800s, in response to a challenge by Napoleon, who desired a higher quality diet for his far-flung armies, the process of canning was developed. By 1945, the stronger and more durable tin and steel cans were widely accepted forms of packaging. During the 1950s, can producers, looking for an economical alternative to the rising costs of tinplate, first began manufacturing aluminum cans. In 1959, the Adolph Coors Company began selling beer packaged in aluminum cans.

The Industrial Revolution

Until the late 1800s, packaging was custom designed, using materials that were available locally. For example, the old cracker barrel was hand built by the store owner or local carpenter, rather than being mass produced from one central location and shipped throughout the country to the place where it was needed. Also, the local butcher or fishmonger would wrap customers' daily purchases in a section of newspaper and the local grocer would supply staples like flour and sugar in large cloth sacks.

The Industrial Revolution in America changed all this. During the early 1900s, as more Americans moved from the farm to the city, food had to be shipped farther from its source and thus had to stay edible for longer periods of time. Food and other consumer products had to be protected throughout the chain of distribution; from the farm or manufacturing plant to the warehouse to the store to the home.

In the 1800s, a farmer's crop was harvested primarily to provide food for the farmer's family, livestock and the neighboring community. Today, less than 3% of Americans live and work on farms. However, the fact that these few Americans can feed more than 240 million Americans and millions more overseas is the result of the successful development of agricultural technology and the development of the distribution systems and packaging necessary to avoid spoilage and waste.

By comparison, some economists have suggested that the depressed status of the former Soviet Union's economy is due not just to archaic farming techniques, but also to poor distribution and packaging systems. Long lines at stores are caused by outmoded methods of distribution. Grocers must hand-pick and hand-wrap each item. The consumer must spend many hours each day shopping for basic necessities. This system of distribution increases waste and spoilage, causing shortages and outright absence of many items.

The supermarket

The shift in the typical American lifestyle caused by the Industrial Revolution prompted another significant development in the history of packaging and food distribution—the creation of the supermarket. Although they have only become commonplace in the U.S. in the last 50 years, most modern American consumers take the conveniences offered by a supermarket for granted.

In this new type of store—which was larger and less specialized than the small shops and local markets it replaced—shopping was self-service. Grocers and clerks could no longer afford the time necessary to individually scoop, weigh and package patrons' purchases. New packages were needed to hold pre-measured quantities of coffee, cereals, salt, sugar and other staples.

To meet this demand, paperboard boxes, steel cans and glass containers were used to ship and store an increasing variety of food and consumer products. During the 1950s, a new packaging material, plastic, was introduced. Plastic packages were less expensive and easier to produce than alternative packages. They were also lighter, resistant to breakage and, consequently, less expensive to ship.

Flexible packages were also introduced during the 1950s. Like rigid plastic containers, flexible packages—made from plastic film, aluminum foil, paper or a combination of these materials—were designed to be lightweight and durable. In addition, they required smaller amounts of raw material to manufacture than their rigid alternatives and, again, were lighter and more cost effective to transport.

The modern distribution system

In contrast to local production and consumption of goods, in a modern distribution system, finished goods are produced in a limited number of locations and then shipped regionally, nationally and internationally. Often the manufacturer does not ship directly to retail outlets, but may, instead, utilize distributors or warehouses to inventory goods and ship them to retail outlets.

A key component of the distribution system in the United States today is transportation. All modes of transportation—rail, truck, air and water—are used to ship goods. But truck transportation in particular, combined with a network of highways unrivaled in the world, has made the efficiency of the American distribution system possible. Today, all types of food and consumer products are rapidly transported from the farm or manufacturer to retail outlets—including specialty shops, drug stores, supermarkets, discount stores, and department stores—all over the country.

Packaging is an essential component of the distribution system in the United States. It ensures that a wide range of food and other consumer products—from farm fresh eggs to clothing to televisions—will be protected against the rigors of the distribution system and arrive at the retail outlet intact and ready for consumer purchase.

Quality of life

The role packaging has played in making the 1990s American lifestyle possible is often overlooked. Today, food and beverage packaging make up about two-thirds of the retail packaging industry. Given the hectic lifestyle of many modern American families, packaging provides flexibility and saves consumers time and money as they shop for and prepare meals. Packaging also enhances the quality of life in lesser developed countries where famine, drought, poor roads and limited refrigeration can seriously impact the availability of locally grown or fresh food products. Packaging improves the quality of life by allowing consumers to purchase products:

- *When they want them.* Today, the world is our grocery store. American consumers are no longer vulnerable to the whims of the growing season, but rather, can readily expect to purchase tomatoes from Mexico or kiwi from New Zealand in the middle of January. Modern food processing and packaging systems allow consumers to purchase fresh, canned and frozen produce at any time of the year. And, unlike the local butcher's shop of 50 years ago, a variety of fresh, frozen and even pre-cooked meats and seafood are available every day in modern supermarkets.

- *At a convenient location.* Modern packaging and supermarkets have virtually eliminated the need for consumers to gather their food purchases from various locations. As recently as the late 1930s, household menu planning typically required daily trips to the butcher, the fish market, the bakery and the produce market. Modern packaging makes the weekly shopping trip possible. In one or two hours, a family can purchase enough food for a week or more.

- *In the quantity desired.* Modern packaging allows consumers to purchase a wide range of food and other consumer products in containers and quantities that are easy to handle and dispense. Rather than carrying sugar home in a 20-pound cloth sack, consumers today can purchase sugar in a variety of packaged quantities including individual packets, 2-pound boxes, and 5- or 10-pound paper bags. Also, rather than buying a whole, uncut chicken at the butcher shop, modern consumers can choose to purchase certain pieces of the chicken.

- *At a reasonable price.* By reducing the likelihood that a product will be contaminated, broken, spoiled or otherwise damaged in the distribution system, packaging helps ensure that prices remain reasonable and competitive. Packages that are lightweight and durable, such as most flexible packages, help control costs because they are less expensive to manufacture and ship than many alternative packages.

Lesson Three
Implementation

Classroom Activity I

Ask students (individually or in groups) to select a product of their choice and complete the necessary research to discover how that product is grown or manufactured, how it is processed, how it is commonly packaged, and how it is transported to retail outlets for consumers to purchase.

For instance, if the product chosen is potato chips, the student will gather information on how and where potatoes are grown, how they are harvested, how they are processed into chips, and how the chips are packaged and distributed to the consumer.

Students should not get "bogged-down" in technical information, but rather, should explain these steps in very general terms. The objective is to foster an appreciation and understanding of the overall manufacturing, packaging and distribution process. You may also encourage students to construct a written or illustrated diagram (flow chart) describing the steps their product must go through before it finally ends up as a packaged product on the grocery store shelf. A sample flow chart for coffee is provided below as an example.

Students may want to write or call the manufacturer of the product to complete the necessary research for this assignment. Provide students with a sample letter that they may follow to write their own letter. Students will want to discover where the product is made, how it is manufactured and the distribution system it follows to make it onto the grocery store shelves. Additional information may be obtained from encyclopedias or reference books. Once the students have completed their research, ask them to present an oral summary of the information they have gathered to the class. Students may want to use a globe or map to trace the products' path.

Sample Flow Chart

Coffee: From Harvest to Supermarket Shelf

1. Coffee beans are grown and harvested in places such as South America and Africa.
2. Coffee beans are sorted by type, bagged in cloth sacks and transported, typically by ship, to a processing plant in the United States.
3. Coffee beans are ground; flavorings, preservatives or other ingredients may be added at the processing plant.
4. Ground coffee is packaged into various containers including steel cans, "brick packs" of very thin layers of plastic film and aluminum foil, glass jars, and plastic jars.
5. Packaged coffee is transported, probably by truck, to a regional warehouse or distributor to be inventoried and stored for future shipment.
6. Packaged coffee is transported, again probably by truck, to retail outlets for consumer purchase. Retail outlets may include family-operated grocery stores, large supermarket chains, small specialty coffee shops and discount stores (e.g. Wal-Mart, Kmart, etc.).

Classroom Activity II

Invite a manager from a local grocery store to visit the class to discuss how improvements in food processing and packaging technology have affected the way grocery stores and supermarkets do business. How has food retailing changed in the last 50 years? In the last 10 years? How do different types of packages (e.g. flexible bags vs. rigid boxes) make it easier or more convenient for grocers to stock and display products in their stores?

Note: *Before the class visit takes place, the teacher should talk with the store manager to provide him or her with a summary and explanation of the packaging topics the students are studying in class. A briefing sheet is provided on the next page. The teacher should ensure that the store manager possesses the experience and knowledge to answer students' questions on these topics. This conversation and the briefing sheet will help the store manager address the packaging topics which are of particular interest to the class.*

Field Trip

With your students, plan a guided tour of your local grocery store or supermarket. Invite the store's manager or other appropriate staff to act as your tour guide. Before leaving the classroom, ask students to identify and list 10 products they would like to examine at the supermarket to discover:

- How each product is packaged when it arrives at the store from the warehouse or distributor.
- How each product is displayed at the store.
- How many packaging choices exist for each of the products selected.
- How each package is designed to make it easier to display or to promote sales.

Supply your product list to the store manager or tour guide in advance of your trip. Ask the tour guide to be prepared to discuss how packaging has changed in the past few years. Ask the grocer to point out the newest types of packages such as the standup pouches for Planters Peanuts and carpet cleaning products.

Extension

The teacher may also consider planning a tour of a local manufacturing facility for flexible packaging. Here, the plant's manager and other staff members should be invited to act as tour guides to provide students with a first-hand explanation of how the plant operates and what it produces. The Flexible Packaging Educational Foundation (FPEF) in Washington, D.C., can provide teachers with information on contacting packaging manufacturers in particular areas of the United States. FPEF's phone number is (202) 842-3839.

Grocers' Sample Briefing Sheet

This briefing sheet is provided to assist you in preparing for your presentation to our class. It summarizes the packaging topics my students have been studying in class. If you have questions before the presentation, please call me during school hours at (phone number).

The package & its functions

- *Containment:* A package provides a way of holding or carrying a product which makes it easier for manufacturers to ship products to stores; for grocers to stock and display different products; and for consumers to carry products home for storage and use.
- *Protection:* A package serves to protect and preserve its contents, ensuring that the consumer receives a usable, uncontaminated product.
- *Information:* A package tells the consumer what is in the package, typically including: the quantity of the product in the package; instructions or precautions for storing and using the product; nutritional, dietary, and ingredient data; and information about the product's manufacturer.
- *Utility-of-use (convenience):* A package makes it possible for consumers to handle, dispense, and use the product it contains.

Types of packages

Modern packages can be grouped into three major types: rigid packages, flexible packages, and packages that combine both rigid and flexible materials. Each type of package provides unique characteristics which can improve the way a product is transported from the farm or manufacturing facility to the grocery store to the final consumer.

Rigid packages are composed of paper, plastic, glass, steel, or aluminum and are characterized by their stiff or unyielding construction. Examples of rigid packaging are cardboard and paperboard boxes; glass bottles and jars; plastic bottles, jars, caps, and lids; and steel or aluminum cans. Rigid packages provide excellent product protection but also require more space to handle, store, display, and dispose of.

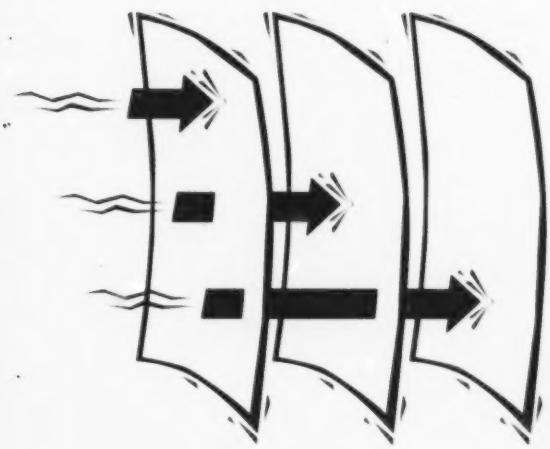
Flexible packages are composed of plastic film, paper, aluminum foil, or any combination of these materials. They have no inherent shape, but conform to the shape of the product, compressing easily and requiring a minimal amount of material to manufacture, particularly when compared to rigid packages. Examples of flexible packaging include plastic wrap that protects meat and poultry; frozen food and microwave bags; bread wrappers and blister packs. Flexible packages provide excellent product protection and preservation and typically cost less to manufacture, ship, and transport.

Rigid and flexible packages are packages which combine both rigid and flexible materials. A good example of this type of package is the "bag-in-box" construction used for foods like cereal, crackers, and cookies.

Packaging & source reduction

Source Reduction: Like preventive medicine, source reduction means less waste in the first place. Less material produced means less material used and ultimately, less to throw away or recycle. For that reason, the U.S. Environmental Protection Agency (EPA) lists source reduction as the best way to reduce the waste generated by households and commercial establishments. By "precycling" rather than recycling, we waste less and conserve more.

Source reduction is equivalent to minimal packaging. In other words, it makes economic sense for a manufacturer to use the smallest amount of materials possible to package a product. Consequently, the finished package will be cheaper to manufacture, will weigh less, and will be less expensive to ship and transport.



barrier properties.

lesson 4

Objectives

After completing this lesson, students will be able to:

- *Define a barrier.*
- *Differentiate between permeable, semi-permeable and nonpermeable barriers.*
- *Define shelf life.*
- *Explain barrier properties and describe their functions in a package.*
- *Test different barriers on a food product.*

Background information

Dr. Robert Testin stated, "By protecting against damage and spoilage, packaging reduces rather than adds to the solid waste stream." Packaging becomes the barrier that protects the product from spoilage, contamination and damage and prolongs the shelf life (the amount of time between the production of a product and the point at which the product first becomes unacceptable under normal conditions). Through scientific research and development, the materials and functions of barriers have changed over time.

By definition, a barrier is the material that limits the transfer of a substance (light, air, water, etc.) into or out of a product. A barrier may be comprised of paper, paperboard, plastic film, glass, ceramic, metals, metal foils or combinations of these materials. Depending on the product being packaged and the materials selected for the package, the barrier can be described as one of the following:

Permeable . . . . . permitting gas, light, aroma or liquids to pass between the product and the environment

Semi-permeable. . . . . permitting only certain gas, light, aroma or liquids to pass between the product and the environment

Non-permeable . . . . . restricting gas, light, aroma or liquids from passing between the product and the environment

Historically, barriers for packaging were limited to non-permeables, specifically glass, metal, and ceramics. With the development of new packaging strategies and materials in the 1930s, semi-permeable and permeable barriers became possible. The liner inside a cereal box provides a good example to illustrate the developments in barrier properties.

In 1906, cereal was packed in a box lined with paper, a permeable barrier. To increase shelf life, a waxed coating was added to the paper and resulted in a semi-permeable barrier that kept more moisture out of the package, thus keeping the cereal fresh longer. Further developments in the 1930s brought liners made with waxed glassine paper. Waxed glassine paper is a greaseproof paper treated with paraffin wax. This procedure restricted even more moisture from entering the cereal, thus further extending its shelf life.

Although the waxed glassine paper restricted some moisture from negatively affecting the cereal, manufacturers were faced with another problem: the wide distribution of the product. Cereals sold in the southeastern section of the United States or during the summer months in the north required a heavier liner to protect against the higher levels of humidity. During the winter months and in more temperate climates, a thinner liner of waxed glassine paper could be used, which reduced the cost of the package and the energy needed to transport the lighter product. For most companies, the dividing line for heavier vs. lighter liners was the Mason-Dixon line. (Ask your students to identify that line and its historical significance.)

Many non-defense industries prospered from new technologies developed during World War II. One of those inventions, plastic coatings, was applied to paper and replaced the heavier waxed glassine for cereal liners. The coatings provided more protection against moisture, strengthened the liner, and reduced the weight. Later, the addition of nuts, raisins, and other dried fruits to cereals required a stronger barrier to keep moisture at a very low level. Coatings were not able to accomplish this task, so cereal manufacturers turned to foil, a better barrier to protect the nuts and fruit from spoilage.

In today's global market, the types of food products distributed are vast. The average grocery store contains more than 10,000 different products, each with unique packaging requirements. Have you ever wondered why cheese is not packaged in a paperboard box? Or why potato chips are not found in glass jars? As discussed above, part of the answer is that the barrier properties of the packaging material may not be adequate to prolong the necessary shelf life of that product.

In addition to keeping foods from spoiling, barriers offer other incentives. Some foods have problems keeping their flavor or aroma and require a barrier that will help lock that flavor and aroma in the product. Some examples are:

- citrus juice—especially orange juice
- food for microwave use
- concentrates
- seasoned, dried entrees for reconstitution with liquids & heat
- fruit flavored foods
- beverages
- spices
- certain candies

Ever leave a container of spices open for an extended period of time? Try it in your classroom and have students examine the product on a daily basis. Ask your students why they think the spices have lost their aroma.

Food products are not the only concern facing packagers when selecting the appropriate barrier. As food products are usually packaged for a quick sale at the consumer level, pharmaceuticals must be packaged to ensure their survival under extreme conditions. Selecting the appropriate barrier for these products is a difficult task. Not only must the barrier protect the drug or product, it must also be designed to undergo processing, sterilization, distribution, storage and consumer or medical use. Barrier designs for pharmaceuticals require protection against many of the same elements as food and beverages; however, it is critical that the barrier protect the product from microbial contamination. For the most part, pharmaceutical barriers must be sterilized before sealing the product. It is a difficult task to create a barrier material that can withstand the sterilization process (radiation, ethylene oxide, steam processing, etc.) without losing its strength.

Because food products are highly perishable and pharmaceuticals require critical protection, barrier properties are critical in the selection of the package for the products. Students will gain a better understanding of the functions of barriers by completing the following activity.

Lesson Four
Implementation

Classroom Activity

Have students wrap pieces of white bread in the following protective barriers: one in foil; one in plastic film (wrap); one in paper (tape should be used to seal the packages); and, one in a sealed, clear, glass jar. For a control, students should leave a piece of bread unwrapped on a plate. The bread slices should be left in a dry, temperate place.

Students should examine the bread on a daily basis and record their findings in a log for a week. What results are recorded for the bread packaged in foil, plastic film, paper, and glass? Lead a discussion on the impact that the barriers had on the bread slices. What conclusions can be reached from the students' findings?

Extension

Recreate the same experiment; however, place the packaged and unpackaged bread slices in a damp place (refrigerator), under continuous bright light, or under a heat lamp. What happens if you use other types of bread (i.e., raisin, wheat, etc.)? Do the results change? Does one barrier provide better protection under these circumstances than under normal room temperatures? Why does this happen?

packaging and source reduction.

lesson 5

Objectives

After completing this lesson, students will be able to:

- *Describe what portion of municipal solid waste is containers and packaging.*
- *Describe how packaging can help minimize waste.*
- *Define source reduction.*
- *Understand how source reduction relates to the concept of minimal packaging.*
- *List three ways in which packaging can support source reduction.*
- *Identify ways that kids can help to source reduce.*
- *Calculate differences in weight among types of packages.*

Background Information

Packaging in municipal solid waste

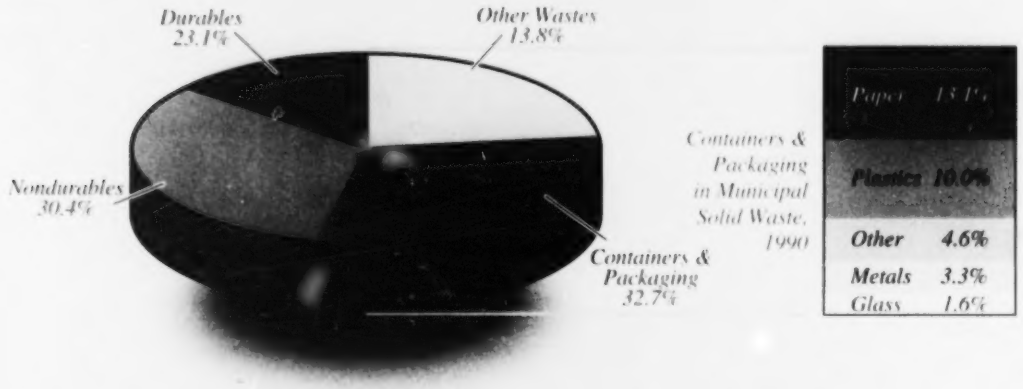
The U.S. Environmental Protection Agency (EPA) has categorized the products found in America's municipal solid waste (MSW) as durable goods, nondurable goods, containers and packaging, and other wastes.

• *Durable goods* are products that have a lifetime of 3 years or more and include major appliances, furniture, rubber tires, and lead-acid automotive batteries. According to the EPA's most recent data, in 1990, durable goods made up just over 23% of all materials found in MSW before recovery for recycling or composting.

• *Nondurable goods* are products that have a lifetime of less than 3 years and include disposable food service products; disposable diapers; clothing and footwear; newspapers, magazines and telephone books; towels, sheets and pillowcases; and third class mail. In 1990, nondurable goods comprised a little more than 30% of all materials generated in MSW before recovery.

• Containers and packaging are made of several materials including paper and paperboard, glass, ferrous metals, aluminum, plastics, wood, and small amounts of other materials. According to the EPA, containers and packaging made up about 33% of MSW before recovery efforts (recycling and composting) were considered. The amounts of each type of packaging material found in MSW are represented in the following pie chart.

Products in Municipal Solid Waste by Category, 1990



Source: Franklin Associates, Ltd. *Characterization of Municipal Solid Waste in the United States: 1992 Update Final Report*, U.S. Environmental Protection Agency, July 1992.

• Other waste includes food wastes, yard wastes, and other miscellaneous inorganic wastes. This category makes up nearly 14% of all MSW generated in the United States.

At first glance, many Americans may think the percentage for containers and packaging is very high. This perception arises in part from the fact that packaging—particularly food packaging—is very visible to the typical American consumer. We see it in our household trash every day. It is useful, however, to consider some of the items that we do not see in our household trash every day, due in large measure to the superior packaging processes used in the United States.

For example, a recent study found that residents of Mexico City produce 40% more garbage per household than their U.S. counterparts. One of the reasons is the use of considerably less packaging and prepared food in Mexico. Consequently, Mexican waste contains a great deal more organic waste (fish heads, animal entrails, corn husks, pods, rinds, and hulls) and much more spoiled, inedible food than that found in U.S. landfills. In fact, many U.S. companies are converting their organic waste to other uses such as feed for livestock. Indeed, food spoilage in the United States today averages less than 3% for processed food and 10-15% for fresh food. In lesser developed countries where packaging is minimal, such as Mexico, food spoilage rates can reach 50%. The higher volume of food being placed in landfills can create a problem because modern landfills do not allow much biodegradation to occur.

Source reduction: What is it?

Source reduction, put simply, means conserving resources by using the least amount of packaging necessary to do the job. "Least" is gauged by either the volume or weight of the packaging material. In other words, which package is most efficient. Some ways that packaging manufacturers can source reduce include: developing the lightest, thinnest, most compressible materials to reduce the package's weight and volume. For example, the aluminum soda pop cans have been reduced in weight and volume over the past twenty years; redesigning the package is another way to source reduce—a brick pack compared to glass or steel can. Product manufacturers can source reduce by combining or concentrating products, such as shampoo and conditioner in one bottle or concentrated laundry detergent.

Source reduction is not a new idea in the packaging industry; it makes economic sense for a product manufacturer to use the smallest amount of materials possible to package a product. Fewer materials mean the finished package will be cheaper to manufacture, will weigh less, and will be less expensive to ship and transport. As a historical part of doing business, it has always been in the interest of both the product manufacturer and the consumer to avoid the extra costs associated with excess packaging. After all, the manufacturer of any given product is in business to sell that product, not to purchase unneeded packaging.

In the packaging industry, minimal packaging is also often referred to as "light-weighting." Some packages that have experienced significant light-weighting or source reduction over the years are outlined as follows:

- In 1974, 16,500 tons of paper fiber were required to manufacture one billion half-pint milk cartons. Today, 12,750 tons of paper are needed to make the same number of cartons, representing a 23% decrease in the raw materials required. More reduction is offered with mini-sip pouches being used in some school districts to distribute milk and juices. The light weight pouches weigh 80% less and take up 90% less volume than the milk cartons.
- Since 1977, the plastic bottle industry has cut the average weight of a 2-liter PET carbonated beverage bottle from 68 grams to 51 grams, a 25% decrease. (See the glossary of terms for a definition of PET.)
- Standard one-gallon plastic milk jugs weigh nearly 38% less today than they did in the early 1970s.
- Since 1980, the glass packaging industry reduced the average weight of a 16-ounce beverage bottle from 255 grams to 177 grams—over a 31% reduction.
- Some coffee cans are now being made with 10% less metal, a design change that will save nearly 200 million pounds of metal each year. Even more significant, the recently introduced "brick pack" for coffee represents an 88% reduction in the volume of packaging materials versus metal cans.
- Since 1972, 12-ounce aluminum beverage cans have been weight-reduced by over 25%.

Source reduction benefits of flexible packaging

Flexible packages lend themselves particularly well to the concept of source reduction. The three major benefits of flexible packaging, from an environmental perspective, are:

- *Flexible packages generally require less material to manufacture.* When flexible packages are substituted for alternative packages, resources are conserved. For example, S.C. Johnson Company has eliminated more than 80% of the plastic it uses to package its Agree Plus shampoo by switching from a standard plastic bottle to a stand-up plastic pouch. Manufacturers of other consumer products are following this example. For instance, the maker of Pringles potato chips recently introduced a new vacuum-sealed pouch that uses 60% less material than the old spiral-wound canister. The tight vacuum packaging also helps reduce chip breakage. And Procter & Gamble cut plastic by 80% by switching from a box to a bag for its Tide refills.
- *Flexible packages weigh less than rigid packaging alternatives.* For example, juice boxes are 90% lighter than comparable glass bottles, and plastic diaper packages are 85% lighter than the traditional cardboard box. Lighter packages conserve energy by reducing the amount of fuel consumed to ship and transport products to the stores. By saving energy, both the manufacturer and consumer save money.
- *Flexible packages generate less waste to discard.* As a characteristic of their construction, flexible packages are much less bulky and easier to compact than other packages. An example: the "brick pack" coffee package is 88% less voluminous than a comparable metal can. This reduction in volume means that when the package is thrown away, 88% less packaging material will be discarded in the landfill. One of the best ways to extend the life of existing landfills is to substantially reduce the volume of the materials we discard.

What students can do

Students are consumers too, and they use packages. Let's look at some ways your students can reduce, reuse and recycle.

Reduce

- *Young people can look for products with reduced packaging.* Compact discs (CDs) provide a good example. In 1993, the recording industry voluntarily agreed to use minimal packaging for CDs. Rather than being packaged in a cardboard container twice the size of the actual CD, the new jewel box is comprised of just the shrink-wrapped plastic case. This change was a direct result of young people and recording artists demanding a change in the way the CDs were packaged.
- *Young people can encourage adults to purchase concentrated products like laundry soap and fabric softener refills.* For example, by concentrating its formulas for detergents, Procter & Gamble Company has reduced the size of its paperboard detergent cartons by 50% and introduced bags for refills which cut plastic material by 80%. Also, a large "economy size" package generally requires less material to make than several smaller packages. When possible, buy products in bulk.
- *Young people can look for source-reduced packages.* At the store, kids (and adults) can look for products that are packaged in minimal packaging, where the least amount of material is used to preserve and protect the product.

Reuse

- *People can reuse packages as often as possible.* Rather than throwing away their paper or plastic lunch bag each day, students can reuse each bag several times. Or, they can purchase a nylon lunch bag or a durable plastic or metal lunch box. Also, if they're not being recycled, plastic grocery bags can be reused as trash can liners and school tote bags.
- *Students (and teachers) can use both sides of a piece of paper.* Single-sided copies are necessary for some documents, but if both sides of the paper can be used, do it! Also, paper that has been used on just one side can be reused in the classroom as scratch paper for solving math problems or at home as note paper for telephone messages, etc.

Recycle

- *People can recycle.* If your school does not yet have a recycling program in place for items like paper, aluminum cans and the plastic foam trays used in the cafeteria, look into setting one up. Recycling conserves resources, reduces the burden on landfills, and can save your school money on garbage hauling fees. The American Plastics Council has published a free guide for teachers and school administrators entitled *How to Set Up a School Recycling Program*. You may want to call them at 1-800-243-5790 to get more information.
- *Kids can compost.* Kids can observe how nature recycles by constructing a compost bin outside in the school yard or inside the classroom in a bucket. Students will watch as, over time, organic wastes like food scraps are converted into humus, a rich soil-like material. Composting is nature's way of recycling by returning organic wastes to the earth or soil. It is important to remember that unlike composting, organic waste will not degrade in a modern landfill because the lack of oxygen prevents aerobic bacteria from functioning.

While reducing the weight of the package ultimately reduces the volume, it is important to note that landfill space is reduced by the volume of solid waste, not necessarily the weight. Packaging scientists have developed methods to measure the amount of volume reduction; however it is difficult to replicate this technique in the classroom without more advanced technical equipment.

Lesson Five Implementation

Classroom Activity

Students will measure and compare the weight of various packages for potato chips.

Gather several sizes (64 oz., 40 oz., 12 oz., etc.) and types of potato chip containers (bag, tin can, box, canister e.g., Pringles). Have students empty the potato chips and separately weigh the contents and the package. The results should be recorded for each size and type of container. Students will then determine the percentage of package compared to the contents. This can be accomplished by dividing the weight of the contents by the combined weight of the package and contents, then multiplying by 100 to determine the percentage. The same procedure will give the percentage of package material to total weight for the product and package.

Students can create a chart illustrating the results of the experiment.

Discussion Questions

Using the chart, which package uses the least amount of material to contain the most product? What are the advantages of using the various types of packages? What are the disadvantages?

Which of the packaging options produces more waste (by weight) to discard?

Why do packagers offer a variety of choices in the way that the potato chips are packaged?

Math problem: If tin cans of potato chips are recycled at a rate of 35% for all tins purchased, then students may assume that another 65% may end up in a landfill. What would be the total weight of the tins in a landfill (use the information gathered above)? Compare this weight to the total weight of a chip bag, assuming that 100% of the bags go to a landfill. Which package would save more landfill space? Lead a discussion on the advantages and disadvantages of using tins or bags to distribute chips.

Extension

Instruct students to select a package of their choice and think of ways that they could reduce the volume and/or weight of the package without compromising its essential functions. How might it be designed? Ask students to sketch a rough drawing of their proposed package and list at least five reasons why they think the new package performs as well or better than the previous package.

Have students present and discuss their drawings. The class should offer suggestions to improve the design.

creating a flexible package.

lesson 6

Objectives

In completing this activity, students will:

- *Use the information they have learned about packaging functions, characteristics, and source reduction by designing and making their own flexible package.*
- *Explain the functional characteristics and environmental benefits of their flexible package to the class.*

Materials Needed:

- In preparation for this activity, instruct students to collect appropriate quantities of the following materials and bring them into class: aluminum foil, paper and plastic film (wrap) or sheet (drop cloth).
- The teacher should provide pens, pencils, crayons, paints, felt-tipped markers, scissors, tape and glue.
- Instruct students (individually or in groups) to invent a product, name it, and create a flexible package for it.

Package Design Criteria

Students should refer to the following criteria as they design their packages:

- The package should be suitable to the product it contains. Think about the kind of product your package will hold. What is the product like? For instance, is it a liquid or a solid? Is it a food? Is it very durable, or can it be easily broken? If so, does it need a combination rigid and flexible package?

- Try to solve at least one problem as you design and create your flexible package. How can you make your product easier for the consumer to use? Can you add a pour spout to the container? Perhaps a resealable pouch would work. You should also consider how the consumer will discard your package once the contents are used up. How can you design the package so that it uses as little material as possible but still protects the product?

- Be sure your flexible package performs the essential packaging functions: containment, protection and preservation, information, and utility-of-use.

- Think about how a grocery store employee might need to handle, store and display your product for the consumer to see. How can the design of your package make his or her job easier? Does it need a peg hole to hang? How will it stack on the grocery store shelf?

Extension

Packaging Competition

1. During this lesson, students invent and create their own flexible packages. The teacher will decide whether the students should work individually or in teams, depending on the classroom situation. When the students' packages are complete, they should fill out the Flexible Package Entry Form on the following pages, which becomes the basis for judging. Teachers may want to hold the competition among several classes.

2. The teacher for each class participating in the competition should conduct a drawing of his or her students' names to select four students to serve on a judging panel. With the teacher's assistance, the student judges will evaluate and select three semi-finalist package entries from their class. For example, if four classes are participating in the competition, a total of 12 semi-finalist package entries will be selected. The student judges will use the Flexible Package Entry Form and the Judge's Rating Sheet to guide them in making their decisions.

3. A Semi-Finalist Judges Panel selects the overall first, second and third place winners of the competition. Using the Sample Letter of Invitation as a guide, teachers may assign each class participating in the competition to write an invitation to one or two community leaders who might serve as members of the Semi-Finalist Judges Panel. Once assembled, the panel should include at least four members. Potential judges may include local business people, flexible packaging manufacturers, civic leaders, waste management experts, congressmen, clergy, editors, reporters, broadcasters, and members of the Chamber of Commerce, Jaycees, Rotary, Kiwanis, or other interested organizations.

The judges will use the Flexible Package Entry Form and the Judge's Rating Sheet to guide them in making their decisions. The packages themselves are placed on display so that the judges can examine them closely. The judges should have a large, clear table top on which to view the packages and write comments on the rating sheets.

The judging also creates an opportunity for civic and business leaders to visit the school, helping to build a bridge between the educational, civic and business communities.

The judging should not be lengthy, and judges should not be expected to make a large commitment of their time. You should be on hand to give them guidance and background about the competition and to answer any questions they may have.

Remember, this is a chance for your students and your school to shine in the eyes of the community, so use every opportunity to garner favorable publicity.

4. The overall winners of the competition will be recognized at a special ceremony. The winners' awards will be shared with the class they represent. First, second and third place winners will receive certificates of merit suitable for framing. These certificates are provided by the Flexible Packaging Educational Foundation (FPEF) in Washington, D.C. In addition, the FPEF can put you in touch with a packaging company in your area that may be interested in sponsoring additional prizes for the competition. FPEF's phone number is (202) 842-3839. Or you may write to FPEF at the address provided below.

You may wish to discuss with your students just how they would like the awards to be presented. Together, you can make decisions about where and when the ceremony will take place. For example, do you want to have the ceremony during school hours with the other classes there as an audience? Or do you want to schedule the presentation for an evening, when parents can be there to watch? Can you work with your parent/teacher organization to schedule the presentation during one of their regular meetings?

Another important decision is who will make the presentations to the winners. You might consider asking the chairman of the judges panel, your school administrator, the head of the parent/teacher organization, a civic leader or congressional representative. You may want to encourage your students to give this honor to a community leader, so that your class and your school will gain positive visibility in the community.

5. Recognition of your students' efforts comes through publicity. The primary rule of public relations is to put your best foot forward, and then make sure the world knows about it! To your students, their very own school and community are the world, so notify your local media as early as possible.

We have provided a sample news release you can customize to match your situation.
Send your news to:

- The school newspaper.
- The local suburban newspapers.
- Advertising circulars or tabloids delivered door-to-door throughout the community.
- Radio and television (don't forget cable and public access stations).
- Newsletters published by local business, civic groups, the Chamber of Commerce, congressional representatives, religious groups or churches and service groups that are interested in strengthening the community via interaction with the school system.
- ***The Flexible Packaging Educational Foundation***
  1090 Vermont Ave., N.W.
  Suite 500
  Washington, D.C. 20005
  Attention: Director of Education

Flexible Packaging Entry Form
Flexible Packaging Awards Competition

YOUR NAME _____ AGE _____

NAME OF YOUR SCHOOL _____

SCHOOL ADDRESS _____

CITY _____ STATE _____ ZIP _____

PHONE _____

TEACHER'S NAME _____

Flexible Packaging Awards Competition

Please answer the following questions to explain the decisions you made in creating your flexible package.

Describe the product your package contains. Why did you choose this package for this product? _____

What materials have you used to create your flexible package? Why did you choose these materials? _____

What problems did you try to solve in designing your flexible package? _____

How does your package preserve and protect the product? _____

Flexible Packaging Awards Competition

What information does your package provide to the consumer? Why is this information important? _____

_____

_____

_____

Does your package make the product easy for the consumer to use? ❒ Yes ❒ No

How? _____

_____

_____

_____

Does your package make it easier or more convenient (than the current package found in a store) for a grocer to store and display your product? ❒ Yes ❒ No

How? _____

_____

_____

_____

Do you think a flexible package is a good idea for this product? ❒ Yes ❒ No

Why? _____

_____

_____

_____

What other products could be contained in your package? _____

_____

_____

_____

How has the package reduced waste? _____

_____

_____

_____

Flexible Packaging Awards Competition
Judge's Rating Sheet

Product: _____

_____

_____

Judge's Rating Sheet

Creativity

Of product (*25 points possible*) _____

Of package (*25 points possible*) _____

TOTAL (*50 points possible*) _____

Success in Meeting Design Criteria

Constitutes a flexible package (*10 points possible*) _____

Solves a problem (*10 points possible*) _____

Protects and preserves the product (*10 points possible*) _____

Provides useful consumer information (*5 points possible*) _____

Provides ease of use/convenience (*5 points possible*) _____

Reduces waste (*10 points possible*) _____

TOTAL (*50 points possible*) _____

GRAND TOTAL (*100 points possible*) _____

Comments: _____

_____

_____

_____

_____

Flexible Packaging Awards Competition
Sample Letter of Invitation

(Letter should be typed or neatly hand-written on school letterhead.)

Sample Letter of Invitation

(Date)

The Honorable Henry Jones
123 Main Street
Lima, OH 03210

Dear Congressman Jones:

The fifth–grade class at Midtown Elementary in Lima is planning a very special event: the Flexible Packaging Awards Competition. We are writing to invite you to join us as a member of the Judges Panel for this event. We are also sending invitations to other community leaders, including (name), (e.g.) Lima's recycling coordinator, and (name), (e.g.) community relations director at the Chamber of Commerce.

During the last few weeks, Midtown's fifth–grade students have been studying the role of packaging in modern society. The students recently completed one of the final packaging assignments—each student created a product and a unique flexible package to suit the product. Last week a competition was held by the students to evaluate all of the product/package entries and select three semi-finalist entries from each fifth–grade class.

Twelve semi-finalist entries were selected. These entries will be evaluated by our Judges Panel to determine the overall first, second and third place winners. Details on the final competition follow:

What: Flexible Packaging Awards Competition
Judging of Semi-Finalist Entries

When: Monday, March 22, 1993
1:00 p.m. - 2:00 p.m.

Where: Midtown Elementary School (Library)
345 Flower Lane
Lima, Ohio

We appreciate your consideration of this invitation and look forward to your reply by (date). To R.S.V.P., please call Ms. Mary Jones at (school phone number). Ms. Jones is the fifth–grade teacher coordinating the Judges Panel.

Sincerely,
The Fifth Grade Class
Midtown Elementary

Flexible Packaging Awards Competition
Sample News Release

(Note: Use before competition.)

For Immediate Release: (date)

Contact: (Teacher's name)
(School phone #)

Sample News Release

Midtown Elementary Students Create Packaging

LIMA, OHIO—Fifth graders at Midtown Elementary School will get a lesson in marketing, manufacturing, and environmental responsibility when they try their hand at designing and developing flexible packaging for products. Midtown Elementary students will be entering their own packages in the Flexible Packaging Awards Competition on March 22.

The objective of this lesson and award competition is to teach children how to apply the principles of science and art to the real world. By taking familiar objects like consumer packages, the students are taught what objects are made of and why. Through this lesson, students will learn physics, economics, and marketing as they are shown how packages must preserve and protect a product; keep it safe from contamination, spoilage or tampering; prevent it from damage or destruction; and provide information and instruction to consumers.

In addition, the students will be introduced to the environmental concept of source reduction, or finding ways to reduce the weight and volume of the material that will need to be disposed.

If history is any indication, the students will come up with some remarkably innovative and well thought out ideas. Previous student packaging competitions have produced a stand-up detergent pouch featuring portion control, a carrying handle, and resealability; a see-through package for motor oil with windows enabling the consumer to see how much is left; a double-lined dog food bag to prevent dampness and product spoilage; and a bird seed bag with a triangular shape to prevent spillage.

The students who create the most outstanding packages during the packaging competition will receive certificates of merit from the Flexible Packaging Educational Foundation in Washington, D.C. (Note: Other locally sponsored prizes should also be listed here.) The final judging for the competition will be held March 22, 1995, at 1:00 p.m. in the library of Midtown Elementary School, 345 Flower Lane, in Lima.

# # #

Flexible Packaging Awards Competition
Sample News Release

(Note: Use following competition.)

For Immediate Release: (date)

Contact: (Teacher's name)
(School phone #)

Innovative Packaging Created By Local Students

Sample News Release

LIMA, OHIO—A reclosable spout that automatically controls portions for dispensing detergent from a plastic bag, and which can be resealed in the bag after use, is an innovation you might expect to see in a store. The most amazing part of this innovation is the fact that it was created not by a team of packaging engineers, but by 11-year-old Sarah Jane Smith, a sixth-grade student at Midtown Elementary School. Guiding her along the way was her teacher, Judith Evans.

This innovative package, incorporating a carrying handle for convenience and enough rigidity to allow efficient storage, won Sarah first place honors in the Flexible Packaging Awards Competition, sponsored by the Flexible Packaging Educational Foundation (FPEF), headquartered in Washington, D.C.

Second place honors went to classmate Andy Smith for his plastic-and-paper package of transmission fluid which enables the user to see when the supply is low.

Third place honors went to classmate Kim Robinholt for her triangular bird seed package with a convenient funnel for dispensing the product, controlling the flow and minimizing spillage.

The FPEF awarded certificates of merit to each of the prize winners. (Note: locally sponsored prizes, if any, also should be listed here.)

Midtown Elementary is one of several area schools that has taken part in FPEF's packaging competition program, designed to teach young people the scientific and environmental principles behind package design and engineering.

Judging the Flexible Packaging Awards Competition were several area civic and business leaders who volunteered their time for this community-strengthening activity. Serving on the judging panel were Congressman Henry Jones, Mayor Edward Avery, PTA President Susan Sorrels and area businessman Malcolm Palmer.

The awards will be presented by Congressman Jones during a special ceremony, (date), at the monthly meeting of the Midtown PTA.

Flexible packaging is composed of either plastic film, paper, aluminum foil or any combination of these materials. It has no shape of its own, but conforms to the shape of the product, compressing easily and requiring a minimal amount of material to manufacture.

# # #

Answers to Pre-Test on page 5

The answers to the questions were provided by Dr. William Rathje, an archaeologist with the University of Arizona and founder of The Garbage Project, who has spent the last 20 years digging up landfills to study what's in them. In a recently published book, Rubbish!: The Archaeology of Garbage, *Rathje and co-author Cullen Murphy debunk several myths concerning the types of garbage found in U.S. landfills.*

Pre-Test Answers
Environmental Facts & Myths

1) Most products are "overpackaged."

"Overpackaging" is the perception that packaging is used where none is needed. Before reaching a conclusion that something is overpackaged, it is important to remember that packaging is multi-functional. The reasons that a product is put into a package often go beyond simply protecting the product. For example, blister packs for hardware and other products can be cost effective by reducing clerical time in the retail store and limiting shoplifting. A package in this case takes the place of a sales clerk, so its size, shape, color and print must also sell and often explain the product. Some products use a large amount of packaging (e.g. single service portions of condiments or individually wrapped cheese slices) to prevent wasting food and to preserve quality for the occasional user. Some packages are "oversized" to meet legal requirements for label and print size, such as for some over-the-counter drugs. True overpackaging is usually the exception, not the rule, in the U.S. marketplace. Pressures to remain economically competitive will always motivate a product manufacturer to use "less rather than more" packaging for any particular application.

2) Packaging is unnecessary.

The role of packaging in making the modern American lifestyle possible is often taken for granted. Packaging serves a vital function for the protection, preservation and distribution of food and other consumer products. Packaging minimizes food and agricultural waste and makes America's food supply one of the safest and most efficient in the world. The U.S. enjoys the world's least expensive food supply and lowest spoilage rate (less than 3%). Many parts of the world lack a U.S.-style packaging and distribution system. Consequently, food safety, food supply, and food spoilage are common problems. In the former Soviet Union, losses of 50% or more of a harvest—from field to consumer—are not uncommon. Also, due to many significant advances in food processing and packaging, the time homemakers in the U.S. spend in daily preparation of food has dropped by 80% in the last 50 years. Today, packaging reflects the needs of consumers, from offering easy-to-open and resealable single-serve products for elderly Americans, children and singles, to bulk economy packs for larger families. Packaging also provides the consumer with important information about the product he or she is purchasing, including: the quantity of product contained in the package; ingredient and nutritional data for the product; and instructions on how to properly store, dispense, use or prepare the product.

3) Recycling is the single best way to solve our waste management problems.

Today recycling is seen by many Americans as the only answer to our waste management problems. But even though it should be supported and encouraged, recycling alone cannot realistically solve all our waste problems. Indeed, it is just one of the waste management methods recommended by the U.S. Environmental Protection Agency (EPA). The EPA suggests that American communities consider adopting an integrated approach to managing their municipal solid waste. This approach is comprised of four sequential steps: source

reduction, recycling (including composting), combustion with energy recovery, and sanitary landfill disposal. Even the most effective recycling programs cannot handle all of the materials found in municipal solid waste. Some materials will always need to be discarded in the landfill. It makes good business and environmental sense for manufacturers to reduce the weight and volume of packaging materials without sacrificing protection or preservation of the product. If packages are consistently "source reduced," those that ultimately end up in the landfill will occupy as little space as possible. Also, with landfill space at a premium in some parts of the country, it may make more sense to burn some waste materials, recover their energy value to generate electricity, and then bury a substantially reduced quantity of ash in the landfill. Integrated waste management advocates recognize that no single waste management method can effectively address America's garbage problems. Even recycling has its costs. Many Americans have come to believe that recycling programs are free and that recycling processes are environmentally benign. Neither is true. Recyclable commodities such as aluminum, glass, paper, plastic and steel must be sold at a reasonable price to make recycling an economically viable enterprise for any community. Also, all recycling processes consume energy and create pollution, including emissions to air and water.

Pre-Test Answers

4) Plastic is the biggest contributor to America's landfills.
Based on the results of numerous landfill excavations, Rathje asserts that "the volume of all plastics—foam, film and rigid; toys, utensils and packages—amounts to about 16% of all garbage buried in a typical landfill." By comparison, paper products—including newspapers, various types of packaging and telephone books—can typically comprise as much as 40% of a landfill's contents. Related to the misperception that plastics are a big waste management problem is the idea that the plastics industry uses huge amounts of crude oil to manufacture plastic products. In fact, less than 2% of all the crude oil refined in the U.S. each year is used to make plastic resins for thousands of items including tableware, furniture, aircraft and automobile parts, computer components, luggage, surfboards, helmets, medical supplies and packaging. Most of the crude oil refined for use in the U.S. becomes gasoline, diesel fuel, home heating fuel and jet fuel.

5) A lot of biodegradation occurs in landfills.
According to Dr. Rathje, "Under normal landfill conditions—in which garbage is covered with dirt after being dumped, and the landfill is kept relatively dry—the only types of garbage that truly decompose are certain kinds of food and yard waste. And these obligingly biodegradable items account for less than 10% of the average landfill's contents. Even after two decades, a third to a half of supposedly vulnerable organics remain in recognizable condition." Indeed, researchers with The Garbage Project have excavated coloring book pages, onion parings, carrots, whole hot dogs and newspapers, which, after more than 10 years in a landfill, were readily identifiable. The fact is that modern landfills are intentionally designed to inhibit decomposition of the wastes contained within them. This is accomplished by substantially limiting the amount of air, moisture and sunlight entering the landfill environment. According to Rathje, "Landfills are not vast composters; rather, they are vast mummifiers. But no need to panic. This may be a good thing. For while there are advantages to biodegradation, it is unquestionably true that the more things decompose in a landfill, the more opportunities there will be for a landfill's noxious contents to come back and haunt us."

Pre-Test Answers

6) Fast-food packaging, polystyrene foam and disposable diapers are major constituents of American garbage.

According to surveys conducted by Garbage Project researchers, many Americans believe that these three products, taken together, comprise at least 70% of the contents of a typical U.S. landfill. In reality, fast-food packaging makes up no more than one-third of 1% of the total volume of the average landfill. Additional landfill excavations have yielded similar results for expanded polystyrene foam—used to make egg cartons, meat trays, coffee cups and packaging materials. According to Rathje, "all the expanded polystyrene foam thrown away in the U.S. every year accounts for no more than 1% of the volume of landfilled garbage." As for disposable diapers, they typically make up "no more than 1% by weight, and not more than 1.4% by volume, of a typical landfill's solid waste content." In other words, these three products comprise less than 3% of the total volume.

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Further Reading

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Rzepecki, Edward L. Packaging and Environmental Issues. St. Paul, MN: University of St. Thomas Technology Press, 1991.

Periodicals

Advanced Packaging
P.O. Box 159
Libertyville, IL 60048
(708) 362-8711

BioCycle
419 State Avenue
Emmaus, PA 18049
(215) 967-4135

Buzzworm
2305 Canyon Blvd., Suite 206
Boulder, CO 80302
(303) 442-1969

Canadian Packaging
245 Fairview Mall Drive, #500
Willowdale, Ontario M2J 4T1 Canada
(416) 490-0220

Chemical Packaging Review
P.O. Box 3144
West Chester, PA 19381-3144
(215) 436-8282

Converting Magazine
455 N. Cityfront Plaza Drive
Chicago, IL 60611
(312) 222-2000

Earthwatch
680 Mount Auburn Street
Watertown, MA 02272-9104
(617) 926-8200

E Magazine
P.O. Box 5098
Westport, CT 06881
(203) 854-5559

Environment Today
1483 Chain Bridge Road, Suite 202
McLean, VA 22101-4599
(703) 448-0322

Garbage
2 Main Street
Gloucester, MA 01930
(508) 283-3200

Package Printing & Converting
401 North Broad Street
Philadelphia, PA 19108
(215) 238-5300

Packaging
1350 E. Touhy Avenue
Des Plaines, IL 60018-3303
(708) 635-8800

Packaging Digest
455 N. Cityfront Plaza Drive
Chicago, IL 60611
(312) 222-2000

Packaging Strategies
122 S. Church Street
West Chester, PA 19382-3223
(215) 436-4220

Paper Film & Foil Converter
29 North Wacker Drive
Chicago, IL 60606-3298
(312) 726-2802

Packaging World
1011 East Ontario, Suite 560
Chicago, IL 60611
(312) 751-1616

Recycling Times
1730 Rhode Island Ave., N.W. #1000
Washington, D.C. 20036-3196
(202) 861-0708

Recycling Today
4012 Bridge Avenue
Cleveland, OH 44113-3320
(216) 961-4130

Resource Recycling
P.O. Box 10540
Portland, OR 97210-0540
(503) 227-1319

Waste Age
1730 Rhode Island Ave., N.W. #1000
Washington, D.C. 20036-3196
(202) 861-0708

Additional Information

The following organizations can provide additional information on topics related to packaging, its environmental impact and waste management.

Aluminum Association
900 19th Street, N.W., Suite 300
Washington, D.C. 20006
(202) 862-5100

American Chemical Society
1155 16th Street, N.W.
Washington, D.C. 20036
(202) 872-4075

American Forest & Paper Association
1111 19th Street, N.W.
Washington, D.C. 20036
(202) 463-2420

American Plastics Council
1275 K Street, N.W., Suite 400
Washington, D.C. 20005
(202) 371-5319

Aseptic Packaging Council
1000 Potomac Street, N.W., Suite 401
Washington, D.C. 20007
(202) 333-5900

Can Manufacturers Institute
1625 Massachusetts Avenue, N.W.
Washington, D.C. 20036
(202) 232-4677

Center for Plastics Recycling Research
Rutgers University, Building 3529
Busch Campus
P.O. Box 1179
Piscataway, NJ 08855-1179
(201) 932-3679

Council on Packaging in the Environment (COPE)
1001 Connecticut Avenue, N.W., Suite 401
Washington, D.C. 20036
(202) 331-0099

Flexible Packaging Association
1090 Vermont Avenue, N.W., Suite 500
Washington, D.C. 20005
(202) 842-3880

Foodservice and Packaging Institute
1901 North Moore Street, Suite 1111
Arlington, VA 22209
(703) 527-7505

Glass Packaging Institute
1801 K Street, N.W., Suite 1105-L
Washington, D.C. 20006
(202) 887-4850

Institute of Packaging Professionals
481 Carlisle Drive
Herndon, VA 22070-4819
(703) 318-8970

National Polystyrene Recycling Company
25 Tri-State International
Lincolnshire, IL 60069
(708) 945-1991

National Recycling Center
1101 30th Street, N.W., Suite 305
Washington, D.C. 20007
(202) 625-6404

Packaging Machinery Manufacturers Institute
4350 North Fairfax Drive, #600
Arlington, VA 22203
(703) 243-8555

Plastic Bag Information Clearinghouse
1201 Connecticut Avenue, N.W.
Washington, D.C. 20036
(202) 223-2214

Polystyrene Packaging Council
1025 Connecticut Avenue, N.W.
Washington, D.C. 20036
(202) 223-2214

Solid Waste Information Clearinghouse (SWICH)
P.O. Box 7219
Silver Spring, MD 20910
Hotline: 1-800-67-SWICH

Steel Recycling Institute
680 Andersen Drive
Pittsburgh, PA 15220
1-800-876-SCRI

U.S. Environmental Protection Agency (EPA)
401 M Street, S.W.
Washington, DC 20460
Public Information Center:
(202) 260-2080

Glossary of Terms

Acid
Any compound that can react with a base to form a salt.

Acidic
Containing an excess of acid-forming substance.

Barrier
The material that limits or blocks the transfer of a substance into or out of a product.

"Brick Pack"
A flexible package made of plastic film and aluminum foil used as a container for products like vacuum-packed coffee and peanuts.

Canister
A rigid container, generally round or rectangular, made of fibre, metal or combinations thereof, designed to pack or store dry products of not more than 5 lb. in weight and have a replaceable top or cover.

Compatibility
Ability of container, whether lined or unlined, to resist degradation of or by the product contained.

Compost
A mixture of decomposing vegetable refuse for fertilizing and conditioning the soil.

Discard
To throw away, abandon or get rid of, as no longer valuable or useful.

Disposable
That which can be thrown away after use.

Distribution System
The process by which commodities get from the farm or factory to the final consumer, including storing, selling, shipping and advertising.

Distributor
A person, agent or business that distributes goods to consumers or dealers.

Durable
Lasting despite hard wear and or frequent use.

Ferrous
Containing or derived from iron.

Flexible Packaging
Packaging involving the use of such pliant materials as foils, films, paper, flexible sheeting, etc., to form the container; for example, wraps, bags, labels and pouches.

Laminant
An adhesive designed for the purpose of combining and bonding a combination of films, foils, plastics, papers or other materials in sheet or web form.

Landfill
A place to dispose of solid waste by spreading it in compacted layers and covering it, usually daily, with soil or other materials.

"Light-Weighting"
In the packaging industry, the practice of manufacturing containers or packages with smaller amounts of materials while retaining all essential packaging functions.

Manufacture
The making of goods and articles by hand or machinery, usually on a large scale.

Molten Glass
Glass which is melted and cast in a mold.

Municipal Solid Waste (MSW)
Refuse or garbage generated in homes, institutions and commercial establishments, including schools, hospitals, restaurants and business offices.

Non-durable
Items which are not manufactured to last for a significant amount of time.

Organic
Having the characteristics of, or derived from, living organisms.

Glossary of Terms

Package
The enclosure of products or items for the purposes of containment, preservation and protection, ease of use, and identification of contents.

Paperboard
The distinction between paperboard and paper is not sharp but, broadly speaking, paperboard is heavier, thicker and more rigid than paper.

PET
Polyethylene terephthalate, the plastic resin from which items such as soda bottles and polyester fiberfill are made.

Raw Material
Material still in its natural or original state, before manufacture or processing.

Recycling
Collecting discarded materials and processing them into new forms which can be used as raw materials for new products.

Rigid
The characteristic of being durable or stiff.

Rigid Container
A package or container made of relatively unyielding materials that require tools and power of high temperatures to change their configuration, chiefly metals, ceramics (including glass), and plastic bottles and containers. Also, a package that, after filling and closing, requires force greater than manual strength to change its shape or configuration, even if the package has been fabricated from materials that, like paperboard, would normally be regarded as somewhat flexible.

Solvent
A substance, usually liquid, that dissolves or can dissolve another substance.

Source
That from which something comes into existence, develops or derives.

Source Reduction
Efforts by individuals or businesses to reduce the amount and toxicity of materials entering the waste stream.

Tinplate
Sheets of iron or steel plated with tin.

Toxicity
The level of toxins which are emitted in the manufacture, use or disposal of an item or product.

Vacuum Packaging
Packaging in containers, whether rigid or flexible, from which substantially all air has been removed prior to final sealing of the container. Purposes for vacuum packaging are: 1. to remove sufficient air to protect the contents from undesirable effects of oxygen, e.g., flavor alteration, bacterial or mold growth, discoloration, etc.; 2. in flexible packaging, to immobilize the contents and diminish volume; and 3. to permit introduction of controlled atmospheres such as nitrogen or carbon dioxide, to prevent deformation, enhance appearance and further protect contents, as in vacuum packaging of coffee, nuts, dried milk solids, etc.

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